Chapter -I

INTRODUCTION
INTRODUCTION

The major preoccupation of the first generation of development economists in 1950 has been the initiation and acceleration of economic growth on the assumption that growth will automatically lead to a more equitable distribution of income and thus be more conducive to social justice. The experience of the developing countries in the last two decades has shown that inspite of respectable achievements in the rates of growth in Gross National Product, social equity aspects of development record have turned out to be disappointing and it has been tragic that the low end poverty groups have not received more of the benefits of growth. Instead of a trickling down of income to the poorest and a reduction in the numbers below the poverty line, there has actually been an increase in the enormous number of people suffering from what the World Bank terms absolute poverty.1

The goals of development have been viewed and interpreted in a broader context than simply growth in Gross National Product. The situation revealed that the lack of income generation and inequitable distribution have kept more people in hunger than has a failure to expand food production. The poverty problem is a reflection of low levels of per capita income but highly unequal distribution patterns are also important. More recently there has been a change of emphasis from mere aggregate measure of Gross National Product to the consideration of its composition and distribution. It is also

1
realized that to reduce hunger, the employment and income effect of agricultural development are much more important than increasing food output per se. This calls for *redistribution with growth or reduction of absolute poverty or meeting of basic human needs* elements of a revised development strategy and this change of emphasis from national product to individual welfare provoked economists, policymakers and politicians to think that the twin objectives of growth and social justice are conflicting and contradictory rather than complementary.  

In India, different strategies based on different models have been used for achieving rapid progress in agriculture. Prior to Independence, crash programmes like Grow More Food Campaign were initiated in the country with the objective of encouraging and assisting cultivators in increasing their production and income with special emphasis placed on bringing the idle land under the plough. But it has failed to eliminate the weaknesses in Indian agriculture and benefited only the affluent farmers, neglecting vast mass of small farmers and others. It was realized that efficient utilization of resources in the farm sector depends on the education of farmers in the proper utilization of resources. With this view, growth-oriented programmes of Community Development and National Extension Programmes were initiated during 1950. During 1960 in India by rapid adoption and use of modern technology in agriculture. With a view to gain self-sufficiency in food grains, a basic requirement for
self-reliance in the development process and to make far greater and widespread use of modern methods of production and to bridge the gap between demand and production by application of the latest advances in the science of agriculture and to raise the level of farm income to enable agriculture to contribute directly to economic growth. **New Agricultural Strategy** has been evolved during mid-sixties.³ The introduction of high yield crop varieties is one of the more significant changes taking place in India agricultural sector and thus technological change concealed under better training, research, extension and institutional framework plays a very crucial role in minimizing the gap between such production potential and actual level of production since the yield potential and income generating capacity of the modern variety are significantly superior to those of the traditional crops, when properly cultivated.⁴

Further, some of the technical characteristics like non-photo period sensitiveness, their response to heavy doses of fertilizers in terms of grain of new varieties seemed to hold out a promise of widespread use of these varieties and a substantial increase in the rate of growth of aggregate food grains production in less developed countries like India. Thus the new technology was seen as setting off a *Green Revolution* or a *Seed-Fertilizer Revolution*. These advantages have led some observers like Brown to predict the end of food grain problem in less developed countries and the beginning of an era of worldwide surplus production.⁵
The new technology which is said to herald the transformation of Indian agriculture from a traditional to a modern one has brought in its wake many short and long-run implications for the economy in general and for the farm sector in particular. One of the short-run effects is an increase in the incomes of those farmers who use new inputs and whose pay-off is high. A still more important aspect is the effect of new technology on the pattern of income distribution among farmers of different sizes. Wharton observes that the new agricultural technology constitutes a cornucopia for the developing world, but it also opens a Pandora box as its very success will produce a number of new problems. Equity problems that arise in the wake of Green Revolution are characterized as second generation problems by Wharton. Falcon draws a distinction between the first, second and third generation problems. The first generation problems relate to the extension of the Green Revolution, the second generation problems include problems of marketing, storage, transportation and resource allocation and the third generation problems concern equity, welfare and employment. The second generation problems are being felt and shortage of storage space and transport facilities are increasing in the wake of bumper harvests in certain years. Regarding the third generation problems, many have expressed grave concern about the adverse effects of the Green Revolution as the new technology is scale neutral but not resource neutral.
On the other hand, some recent studies reveal that a more uniform pattern and level of adoption of new technology among farmers led to a drop in the farm income inequality. The conclusions arrived at by the studies on this issue are contradictory and there is no consensus among writers as to the impact of new technology on income distribution.

TECHNOLOGICAL CHANGE AND AGRICULTURAL GROWTH

The New Strategy of Agricultural Development consists of (A) High yielding variety programme, (B) Incentive paddys for the producer farmers, (C) Development of infrastructure consisting of credit, marketing, storage, research, education and training, power generation, transport and communications and administration, (D) Development of irrigation facilities, (E) Supply of all non-traditional production inputs like fertilizers, pesticides, seeds, etc., (F) Plant protection and pest control operations, (G) Multiple cropping programme, (H) Dry land farming and (I) Small farmers and marginal farmers development programmes.8

The high yielding varieties are land substituting and labour using innovations. As they are neutral to scale, they are usable by all farmers regardless of farm size. With their rapid and full-fledged spread, they could break the chains of rural poverty in important parts of the world. They may be to the agricultural revolution in poor countries what the steam engine was to the industrial revolution in Europe.9 Since new technology is input demanding particularly
water, fertilizers and credit, it has developed in pockets where the above inputs are easily available. A number of studies so far carried out do suggest some features of high yielding varieties. The studies have brought out that high yielding varieties have flourished more in states like Haryana, Punjab and Tamil Nadu. There are conflicting views about the contribution of high yielding varieties to agricultural growth. The area under important crops in India is presented in Table-1.1.

Table-1.1
Area under Principal Crops in India
(in Million Hectares)

<table>
<thead>
<tr>
<th>Year</th>
<th>Paddy</th>
<th>Wheat</th>
<th>Jowar</th>
<th>Bajra</th>
<th>Maize</th>
<th>Ragi</th>
<th>Sunflower</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999-2000</td>
<td>45162</td>
<td>27486</td>
<td>10252</td>
<td>8898</td>
<td>6422</td>
<td>1634</td>
<td>1289</td>
<td>185124</td>
</tr>
<tr>
<td>2000-2001</td>
<td>44761</td>
<td>25797</td>
<td>9915</td>
<td>10022</td>
<td>6805</td>
<td>1816</td>
<td>1060</td>
<td>185340</td>
</tr>
<tr>
<td>2001-2002</td>
<td>44892</td>
<td>26315</td>
<td>9810</td>
<td>9545</td>
<td>6732</td>
<td>1735</td>
<td>1173</td>
<td>188286</td>
</tr>
<tr>
<td>2002-2003</td>
<td>41314</td>
<td>25273</td>
<td>9341</td>
<td>7934</td>
<td>6784</td>
<td>1488</td>
<td>1684</td>
<td>175580</td>
</tr>
<tr>
<td>2003-2004</td>
<td>42379</td>
<td>26980</td>
<td>9403</td>
<td>10958</td>
<td>7376</td>
<td>1765</td>
<td>2086</td>
<td>190077</td>
</tr>
<tr>
<td>2004-2005</td>
<td>42760</td>
<td>26889</td>
<td>9644</td>
<td>9431</td>
<td>7532</td>
<td>1654</td>
<td>2167</td>
<td>191546</td>
</tr>
<tr>
<td>2005-2006</td>
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<td>26695</td>
<td>8681</td>
<td>9742</td>
<td>7736</td>
<td>1634</td>
<td>2289</td>
<td>193316</td>
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<td>2006-2007</td>
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<td>28400</td>
<td>8459</td>
<td>9577</td>
<td>7775</td>
<td>1329</td>
<td>2142</td>
<td>192491</td>
</tr>
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<td>2007-2008</td>
<td>43621</td>
<td>28597</td>
<td>7803</td>
<td>9674</td>
<td>8039</td>
<td>1523</td>
<td>1891</td>
<td>195156</td>
</tr>
<tr>
<td>2008-2009</td>
<td>45253</td>
<td>27921</td>
<td>7534</td>
<td>8802</td>
<td>8062</td>
<td>1502</td>
<td>1809</td>
<td>195104</td>
</tr>
</tbody>
</table>

From the Table-1.1 observed that the principal crops like majority area paddy, wheat are food crops and sunflower is non-food crops in India. It is quite clear that in both absolute and relative terms, the new varieties have spread more rapidly than the new paddy varieties. Not only in case of India; but also in case of many other countries, the percentage of crop area under high yielding variety of wheat is more than that of high yielding variety of paddy. The comparative analysis of high yielding variety of wheat and paddy indicates that the spread of high yielding variety of wheat is more impressive than high yielding variety of paddy. The principal crops of Andhra Pradesh are presented in Table-1.2

Table-1.2

Area under Principal Crops in Andhra Pradesh

<table>
<thead>
<tr>
<th>Year</th>
<th>Paddy</th>
<th>Wheat</th>
<th>Jowar</th>
<th>Bajra</th>
<th>Maize</th>
<th>Ragi</th>
<th>Sunflower</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999-2000</td>
<td>4014</td>
<td>13</td>
<td>665</td>
<td>138</td>
<td>518</td>
<td>85</td>
<td>278</td>
<td>13411</td>
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<td>2000-2001</td>
<td>4243</td>
<td>14</td>
<td>677</td>
<td>144</td>
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<td>2001-2002</td>
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<td>92</td>
<td>428</td>
<td>82</td>
<td>268</td>
<td>12756</td>
</tr>
<tr>
<td>2002-2003</td>
<td>2822</td>
<td>11</td>
<td>624</td>
<td>87</td>
<td>526</td>
<td>71</td>
<td>417</td>
<td>11559</td>
</tr>
<tr>
<td>2003-2004</td>
<td>2975</td>
<td>12</td>
<td>648</td>
<td>138</td>
<td>721</td>
<td>78</td>
<td>491</td>
<td>12366</td>
</tr>
<tr>
<td>2004-2005</td>
<td>3686</td>
<td>9</td>
<td>500</td>
<td>94</td>
<td>657</td>
<td>69</td>
<td>476</td>
<td>12519</td>
</tr>
<tr>
<td>2005-2006</td>
<td>3982</td>
<td>11</td>
<td>444</td>
<td>81</td>
<td>758</td>
<td>66</td>
<td>444</td>
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<td>422</td>
<td>61</td>
<td>726</td>
<td>59</td>
<td>446</td>
<td>12811</td>
</tr>
<tr>
<td>2007-2008</td>
<td>3984</td>
<td>8</td>
<td>331</td>
<td>74</td>
<td>786</td>
<td>55</td>
<td>426</td>
<td>13567</td>
</tr>
<tr>
<td>2008-2009</td>
<td>4387</td>
<td>14</td>
<td>279</td>
<td>59</td>
<td>852</td>
<td>50</td>
<td>419</td>
<td>13830</td>
</tr>
</tbody>
</table>

From the Table-1.2 observed that the principal crops like paddy, bajra, jowar important crops and non-food crops are sunflower and groundnut in Andhra Pradesh. In Andhra Pradesh paddy and sunflower rapidly increasingly. It is widely agreed that apart from paddy and wheat and to some extent, bajra, the Green Revolution has not affected any of the other crops. The impact on jowar, maize and millet has been adjudged to be mediocre and the same is true of most non-food crops. The Green Revolution is to be measured in terms of the area under high yielding varieties and not in terms of its contribution to the increase in productivity per cropped acre alone. This is because although the major impact of Green Revolution has been a breakthrough in the productivity per cropped acre for the crops concerned, it has also contributed to an increase in the total cropped area through investments in irrigation and the use of short duration varieties. The success and failure of paddy respectively can be explained by many factors. The similarity in the environmental conditions of the major wheat growing areas in India and Mexico, from where high yielding variety of wheat has been imported and the well-planned plant breeding research carried out in the country are most important factors which contributed to the rapid spread of high yielding variety of wheat. Again the wheat growing areas of Punjab, Madhya Pradesh and Western Uttar Pradesh are relatively more developed as compared to the paddy and millet zones of the country and farmers in wheat growing areas like Punjab and Haryana are more progressive, possessing innovation capacity. These states are
also gifted with large proportion of irrigated area both relatively and absolutely. The high expected income that convinced the farmers of better prospects, the institutional support, detailed planning and coordination at all levels, had created suitable conditions for the rapid spread of sunflower in the country. The new technology is symbolized by the growth in the use of tube wells. A rapid increase in the share of tubewells in irrigation over the past few years. The success of tubewells in Green Revolution areas has influenced the thinking of many irrigation experts in their favour and against large scale canal irrigation schemes. In Punjab and Andhra Pradesh, tubewells are privately owned, mostly by rich farmers who can afford them or can find ways of raising loans to finance the purchase. The data relating to gross area under irrigation by crops in India is given in Table-1.3.
Table-1.3

Gross Area under Irrigation by Crops in India

<table>
<thead>
<tr>
<th>Year</th>
<th>Paddy</th>
<th>Wheat</th>
<th>Jowar</th>
<th>Bajra</th>
<th>Maize</th>
<th>Ragi</th>
<th>Sunflower</th>
<th>Total Gross Irrigated Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>1998-1999</td>
<td>24731</td>
<td>23786</td>
<td>800</td>
<td>662</td>
<td>1372</td>
<td>144</td>
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<tr>
<td>1999-2000</td>
<td>25040</td>
<td>24119</td>
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<td>1466</td>
<td>135</td>
<td>295</td>
<td>79206</td>
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<tr>
<td>2000-2001</td>
<td>24337</td>
<td>22798</td>
<td>826</td>
<td>783</td>
<td>1423</td>
<td>141</td>
<td>255</td>
<td>76187</td>
</tr>
<tr>
<td>2001-2002</td>
<td>24419</td>
<td>23311</td>
<td>726</td>
<td>643</td>
<td>1373</td>
<td>145</td>
<td>275</td>
<td>78420</td>
</tr>
<tr>
<td>2002-2003</td>
<td>21186</td>
<td>22448</td>
<td>712</td>
<td>770</td>
<td>1361</td>
<td>148</td>
<td>397</td>
<td>73411</td>
</tr>
<tr>
<td>2003-2004</td>
<td>22395</td>
<td>24172</td>
<td>692</td>
<td>697</td>
<td>1412</td>
<td>128</td>
<td>485</td>
<td>78147</td>
</tr>
<tr>
<td>2004-2005</td>
<td>23585</td>
<td>24172</td>
<td>765</td>
<td>776</td>
<td>1576</td>
<td>116</td>
<td>582</td>
<td>81181</td>
</tr>
<tr>
<td>2005-2006</td>
<td>25006</td>
<td>24098</td>
<td>714</td>
<td>896</td>
<td>1741</td>
<td>116</td>
<td>560</td>
<td>84257</td>
</tr>
<tr>
<td>2006-2007</td>
<td>25311</td>
<td>25726</td>
<td>682</td>
<td>922</td>
<td>143</td>
<td>88</td>
<td>571</td>
<td>86765</td>
</tr>
<tr>
<td>2007-2008</td>
<td>25216</td>
<td>26033</td>
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<td>993</td>
<td>1962</td>
<td>90</td>
<td>601</td>
<td>87920</td>
</tr>
<tr>
<td>2008-2009</td>
<td>26542</td>
<td>2548</td>
<td>673</td>
<td>831</td>
<td>2068</td>
<td>104</td>
<td>554</td>
<td>88419</td>
</tr>
</tbody>
</table>

Source:– Govt. of India, Statistical Abstract of India, various Issues, New Delhi, 2010.

From the Table-3 shows that in the total irrigated area paddy and wheat high per cent irrigated area in India. Area irrigated of other crops like bajra, jowar, maize and sunflower has also showed an increasing trend over the period. The magnitude of technological change can be assessed either by estimating the increase in output attributable to modern inputs or by measuring the growth in the use of modern inputs themselves. In view of the scarcity of land relative to
labour in Indian agriculture, one would expect the land augmenting inputs to spread at a relatively faster rate than the labour substituting inputs. Recent experience shows that the use of modern inputs like high yielding variety seeds and fertilizers, which are essentially land augmenting, have been spreading at a relatively faster rate than the use of pump sets and tractors which perform the tasks hitherto performed by bullock and human labour. The irrigated areas under principal crops of Andhra Pradesh are presented in Table-1.4.

### Table-1.4

Area under Irrigated Crops in Andhra Pradesh

(in Million Hectares)

<table>
<thead>
<tr>
<th>Year</th>
<th>Paddy</th>
<th>Wheat</th>
<th>Jowar</th>
<th>Bajra</th>
<th>Maize</th>
<th>Ragi</th>
<th>Sunflower</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1998-1999</td>
<td>4141</td>
<td>16</td>
<td>18</td>
<td>135</td>
<td>9</td>
<td>24</td>
<td>NA</td>
<td>13458</td>
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<tr>
<td>1999-2000</td>
<td>3841</td>
<td>27</td>
<td>20</td>
<td>149</td>
<td>10</td>
<td>27</td>
<td>NA</td>
<td>13498</td>
</tr>
<tr>
<td>2000-2001</td>
<td>4041</td>
<td>25</td>
<td>32</td>
<td>161</td>
<td>11</td>
<td>25</td>
<td>51</td>
<td>13545</td>
</tr>
<tr>
<td>2001-2002</td>
<td>3661</td>
<td>25</td>
<td>16</td>
<td>147</td>
<td>10</td>
<td>21</td>
<td>65</td>
<td>12756</td>
</tr>
<tr>
<td>2002-2003</td>
<td>2689</td>
<td>38</td>
<td>15</td>
<td>177</td>
<td>8</td>
<td>16</td>
<td>108</td>
<td>11559</td>
</tr>
<tr>
<td>2003-2004</td>
<td>2805</td>
<td>46</td>
<td>20</td>
<td>232</td>
<td>10</td>
<td>17</td>
<td>140</td>
<td>12366</td>
</tr>
<tr>
<td>2004-2005</td>
<td>2938</td>
<td>43</td>
<td>19</td>
<td>212</td>
<td>8</td>
<td>13</td>
<td>151</td>
<td>12519</td>
</tr>
<tr>
<td>2005-2006</td>
<td>3845</td>
<td>35</td>
<td>18</td>
<td>260</td>
<td>9</td>
<td>12</td>
<td>141</td>
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</tr>
<tr>
<td>2006-2007</td>
<td>3836</td>
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<td>277</td>
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<td>12</td>
<td>150</td>
<td>12811</td>
</tr>
<tr>
<td>2007-2008</td>
<td>3850</td>
<td>28</td>
<td>21</td>
<td>349</td>
<td>6</td>
<td>10</td>
<td>173</td>
<td>13567</td>
</tr>
<tr>
<td>2008-2009</td>
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<td>421</td>
<td>12</td>
<td>8</td>
<td>162</td>
<td>13830</td>
</tr>
</tbody>
</table>

From the Table-1.4 show that the irrigated area increases from
day to day. The principal crops under irrigation rapidly increases
crops like paddy, jowar, bajra and especially sunflower also.

FERTILIZERS

The new varieties have been designed to the highly responsive to
fertilizer intake and as such, along with the spread of high yielding
variety of seeds, the consumption of fertilizers has increased
significantly since mid-sixties in India. With increasing dosages of
fertilizer, the output from traditional varieties grows only to a limited
extent, whereas the new varieties show increasing yields up to a very
high level of fertilizer input.\textsuperscript{10} Traditionally, the level of consumption
of fertilizer in India has been very low. Given the fertilizer
responsiveness of the new high yielding varieties, it is not surprising
that almost all empirical studies in India show a higher level of
fertilizer consumption by the adopters of high yielding varieties,
compared to their traditional counterparts.

The use of fertilizer in most parts of India falls short of the
recommended dosage. Assured supply of water is a prime condition
for intensive application of fertilizers. Absence of this condition over
large parts of the country is one of the important factors which
hamper a more, rapid increase of fertilizer consumption. In India, rabi
crops (food as well as non-food crops) account for only one-third of
our agricultural production. Yet they account for three-fifths of the
total fertilizer consumption. This is because of the better assurance of availability of irrigation or sub-soil moisture for rabi crops.$^{11}$

PESTICIDES AND PLANT PROTECTION MEASURES

New varieties, which are resistant to one type of pests, might be susceptible to attacks from others which have remained dormant for many years. The greatest success of the new varieties of wheat, compared with the new paddy varieties in terms of yield, consistency and adoption rate, is largely due to the superior pest-resistant qualities of the former. In addition to the physical and biological methods of pest control, methods of chemical control through the use of pesticides are being increasingly used in India.$^{12}$

CREDIT

The need for credit for farmers when it observed, Most of the world's farmers have to borrow at sometime many of them heavily to raise agricultural production, they will have to borrow still more. And more is almost always needed where there is redistribution of rights in land. It is thus in the interest of agriculture and essential to agriculture and general progress that credit be available to farmers in adequate amount and at appropriate costs. Adequate and timely credit to the farmer is therefore vital and indispensable for the rehabilitation and progress of agriculture.$^{13}$

All India Rural Credit Survey Committee says the recent growth of competition from institutional credit, there is a decline in the
contribution of non-institutional rural credit. A steady increase in the amount of credit advanced by the commercial banks in India for supporting agricultural activities since their nationalization in 1969. Commercial banks have also been providing finance for agriculture and development activities in the rural sector both directly and indirectly on an increasing scale, particularly since 1970. While the co-operatives look after the short and medium term loans, the long-term loans are disbursed by the Land Development Banks. Since 1960, both the number of primary land development banks and the amount advanced by them have rapidly expanded and the extension of credit facilities through these banks has encouraged the purchase of heavy machinery like tractors and tubewells.

According to Griffin, due to imperfections in credit or money market in underdeveloped countries, the small and marginal farmers are not reaping full benefits out of the new agricultural technology. Due to the resource bias of the new strategy in favour of large farmers, the small and marginal farmers are bypassed in the adoption of the new technology.14

Thus given the very high level of expenditure on inputs needed for high yielding variety cultivation, it is not surprising that a small farmer decision to adopt the new varieties is crucially dependent on his ability to raise the necessary money, usually by borrowing. Traditionally smaller farmers have always been more dependent on credit than larger farmers, the latter often functioning as money-
lenders advancing money at a high interest rate. As long as the use of high yielding varieties largely remains confined to resourceful self-financing farmers, the issue of credit, both the amount and the patterns of distribution does not assume much importance. But a programme for spreading the new varieties to new areas and among less resourceful farmers requires a positive approach on the part of the credit institutions.

FARM MECHANIZATION

Technological changes in general and mechanization in particular have been taking place in India, mainly among the large farms in the high income and high growth pockets. Many agricultural economists would dispute the inclusion of an indivisible factor of production like a tractor as a component of the new agricultural technology alongside divisible inputs like new seeds, fertilizer, pesticides and irrigation. Their opposition follows from their definition of the new technology as scale-neutral which can be introduced by both the large and the small holdings alike, whereas the inclusion of tractors is likely to give it the appearance of being biased towards the larger farmers. However, in most cases where the new technology has been successful, it is difficult to assess its impact independent of the influence of tractorization. The general experience in India is that the areas which boasted a high degree of agricultural mechanization in the past, such as, Punjab and Haryana were among the first to respond favourably to the new high yielding varieties of seeds.
In Punjab and Haryana, two states with the most impressive record of production with the new varieties, tractorization and introduction of the new varieties have been influenced in their case by a third factor, the existence of large, resourceful farmers who have been both willing and able to modernize agriculture. Tractor farms are usually larger, better irrigated and have more highly valued land than bullock farms. There is no doubt that the introduction of new seeds has encouraged the spread and use of agricultural machinery and implements like tractors in Indian agriculture. The need for timely ploughing is greater with the new seeds, and in this, tractors are more reliable than bullocks which take much longer time. The greater emphasis on the cultivation of the high yielding variety crops during the dry seasons is also an important factor contributing to the spread of tractor use, and it is pointed out further that the use of tractors also saves the trouble of rearing bullocks, finding them pastures and managing them in muddy fields.\textsuperscript{15}

Hanumantha Rao offered an important explanation on the \textbf{mechanization paradox} by saying that the cost-saving and output-augmenting effects of tractorization more than compensate for the costs of buying and maintaining this piece of machinery from the point of view of large farmers. He further argues that, there is no technical complementarily between the use of tractors and high yielding varieties because each of them can be used independently of the others. However, among the large farms, costs of hired labour are
higher than for the small family farms and the costs of management and supervision would also be higher. Therefore, the large farms may find it more costly to ensure timeliness of ploughing operations with the biological sources of energy, especially when they plan to allocate large area to high yielding varieties. The use of tractors may enable them to allocate more area economically to the high yielding varieties. Beyond a point, therefore, a complementarily in this sense may emerge between the mechanical and biological-chemical techniques among the large farms. Rao pointed out that the use of fertilizer per acre among tractor farms is twice as high as among non-tractor farms. The biological-chemical inputs lead to a more rapid adoption of mechanical inputs like tractors and pump sets through multiple cropping.16

Empirical evidence suggests that tractorised farms usually produce a higher output per unit of land. But most of these studies fail to isolate the effect of tractorization from other effects, such as irrigation and cropping pattern. The explanation the authors offered for tractorization in this context was that without tractors large farmers were unable to cope with the demands of cultivation.17 A large number of studies especially in Punjab, show the tractor farms as having a higher level of cropping intensity than the bullock farms. But this correlation of tractorization with cropping intensity does not indicate the direction of causation or whether both are influenced by a third factor.18
Though there has been a steady progress in the use of improved implements and machinery in Indian agriculture, a strong controversy is raging about the need for large scale introduction of farm machinery in India. To be weighed in the argument are such facts as substantial increase in farm productivity on the positive side and the displacement of labour, as also the problems of mechanization of small and marginal farmers on the negative side. Therefore, emphasis is to be laid on selective mechanization and development of suitable implements, particularly those needed by small and marginal farms and those suitable for dry land areas.

EXTENSION SERVICES

In the context of new technology, extension services assume greater significance because the adoption of new technology depends on the availability of knowledge, skill and motivation of farmers and a host of other factors. The main tasks of agricultural extension are to transmit the knowledge of advanced technology proved on demonstration farms and to help farmers to adopt the new technology by removing the constraints in its adoption. The gap in the yield levels of developing countries as compared to that of developed countries is an outcome of ignorance and lack of initiative or skill on the part of farmers as generally believed.

In India, agricultural extension system has been limited to the popularization of new techniques of cultivation, use of high yielding variety of seeds, chemical fertilizers and controlled irrigation and the
benefits have mainly been confined to a handful of big farmers in the already developed states of Punjab and Haryana. Agricultural extension services are thus important from the point of equitable distribution of gains of development. Agricultural extension work helps in the optimization of production through effective exploitation of available infrastructural facilities. A new organizational approach known as *training and visit system* has been adopted in 13 states with the World Bank assistance, which provides for simple but effective mechanism for systematic and timely transfer of know-how from the research laboratories to village level workers and from village level workers down to farmers.\(^{19}\)

**PRODUCTION AND PRODUCTIVITY**

The introduction of new technology in 1960 food production in India has increased substantially. Dantwala points out that Indian agriculture has put up a valiant effort to lift itself from stagnation to which it was reduced for half a century prior to Independence and demonstrated its capacity to take big strides on the path of growth. The achievement in food production and productivity in the post-Independence period especially since mid-sixties is quite significant and substantial.\(^{20}\) The magnitude of technological change, according to Rao can be assessed by estimating the increase in output attributable to modern inputs themselves. In the context of the success of the new technology in increasing food production, one can safely assert that there is no evidence to show that a change has not
occurred in Indian food grains production, the evidence does show that increases in output obtained since 1970 are not attributable exclusively to favourable rainfall. In fact, even when the effect of weather is held constant in statistical analyses, the efforts of the new technology show up quite strongly in the form of enhanced output. Thus the earlier gloomy prediction has lost its validity in the context of new technology in India.\(^{21}\) The following Table-1.5 gives data relating to the area, production and yield paddy and sunflower respectively.

**Table-1.5**

**Area, Production and Yield of Paddy and Sunflower in India**

<table>
<thead>
<tr>
<th>Year</th>
<th>Paddy</th>
<th>Sunflower</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Area</td>
<td>Production</td>
</tr>
<tr>
<td>1999-2000</td>
<td>45.16</td>
<td>89.68</td>
</tr>
<tr>
<td>2000-2001</td>
<td>44.71</td>
<td>84.98</td>
</tr>
<tr>
<td>2001-2002</td>
<td>44.9</td>
<td>93.34</td>
</tr>
<tr>
<td>2002-2003</td>
<td>41.18</td>
<td>71.82</td>
</tr>
<tr>
<td>2003-2004</td>
<td>4.59</td>
<td>88.53</td>
</tr>
<tr>
<td>2004-2005</td>
<td>41.91</td>
<td>85.13</td>
</tr>
<tr>
<td>2005-2006</td>
<td>43.66</td>
<td>91.79</td>
</tr>
<tr>
<td>2006-2007</td>
<td>43.81</td>
<td>93.35</td>
</tr>
<tr>
<td>2007-2008</td>
<td>43.91</td>
<td>96.69</td>
</tr>
<tr>
<td>2008-2009</td>
<td>45.54</td>
<td>99.18</td>
</tr>
<tr>
<td>2009-2010</td>
<td>41.85</td>
<td>89.13</td>
</tr>
</tbody>
</table>

Source:- Govt. of India, Statistical Abstract of India, various Issues, New Delhi, 2010.

From the Table-1.5 it is evident that production of paddy, from 45.16 to 41.18 million decreases in India. Especially the production level of paddy 89.68 to 89.13 percent and yield by 1986 kgs to
2130 kgs per hectare in India. In another non food crop sunflower is also 1.29 to 1.48 million hectares, production 6.9 to 8.51 tonnes and 538 kgs to 576 kgs per hectare increased the impact of the green revolution. The increase in agricultural production during the last decade is mainly due to the increase in the area under high yielding variety programme. The following Table-1.6 gives data relating to the area, production and yield paddy and sunflower in Andhra Pradesh respectively.

Table-1.6
Area Production and Yield of Paddy and Sunflower in Andhra Pradesh

<table>
<thead>
<tr>
<th>Year</th>
<th>Paddy</th>
<th></th>
<th>Sunflower</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Area</td>
<td>Production</td>
<td>Yield</td>
<td>Area</td>
</tr>
<tr>
<td>1999-2000</td>
<td>4014.2</td>
<td>10638</td>
<td>2650</td>
<td>278</td>
</tr>
<tr>
<td>2000-2001</td>
<td>4243.0</td>
<td>12458</td>
<td>2936</td>
<td>197</td>
</tr>
<tr>
<td>2001-2002</td>
<td>3824.8</td>
<td>11390</td>
<td>2978</td>
<td>267</td>
</tr>
<tr>
<td>2002-2003</td>
<td>2822.3</td>
<td>7327</td>
<td>2596</td>
<td>416</td>
</tr>
<tr>
<td>2003-2004</td>
<td>2975</td>
<td>8953</td>
<td>3009</td>
<td>491</td>
</tr>
<tr>
<td>2004-2005</td>
<td>3086</td>
<td>9601</td>
<td>3111</td>
<td>444</td>
</tr>
<tr>
<td>2005-2006</td>
<td>3982</td>
<td>11704</td>
<td>2939</td>
<td>446</td>
</tr>
<tr>
<td>2006-2007</td>
<td>3978</td>
<td>11872</td>
<td>2984</td>
<td>426</td>
</tr>
<tr>
<td>2007-2008</td>
<td>3984</td>
<td>13324</td>
<td>3344</td>
<td>419</td>
</tr>
<tr>
<td>2008-2009</td>
<td>4387</td>
<td>14241</td>
<td>3246</td>
<td>350</td>
</tr>
<tr>
<td>2009-2010</td>
<td>3441</td>
<td>10538</td>
<td>3062</td>
<td>376</td>
</tr>
</tbody>
</table>

From the Table-1.6 it is evident that production of paddy, from 4014.2 to 3441 hectares decreases in Andhra Pradesh. Especially the production level of paddy 10638 to 10538 million tonnes and yield by 2650 kgs to 3062 kgs per hectare in Andhra Pradesh. In another non food crop sunflower is also 278 to 376 million hectares, production 159 million tonnes to 370 million tonnes and 572 kgs to 771 kgs per hectare increased the impact of the green revolution.

Ashok Rudra points out that for the country as a whole, and agriculture in particular, the strategy has not succeeded. The general conclusion that one can draw is that there has indeed been a breakthrough in production conditions for some crops and in some regions but no such thing has taken place for all crops and in all regions.22

At the farm level, several studies have brought out the yield raising characteristics of high yielding varieties. At the same time they have also shown that its yield potential has not yet been tapped because of the gap between the recommended and actual dosages of application of certain key inputs. The factors responsible for this lacuna are institutional requisites, lack of extension services, lack of credit facilities, etc. Studies have attempted to measure the magnitude of change in terms of output and yield. These studies have shown that considerable improvement at aggregate level has taken place only in wheat. On the whole, the effects of Green Revolution on output and yield of food grains crops have been mixed, spectacular for wheate, some
improvements for bajra and maize and no improvement at all for jowar
and paddy. In some, the extent of Green Revolution has been small,
both in terms of area covered and impact on output. Hence, there is
every need to achieve a breakthrough particularly in respect of paddy,
which occupies the major part of the cropped area and also grown all
over the country. This not only contributes to higher production but
also reduces uneven distribution of the benefits of Green Revolution
among regions in the country.23

ACTUAL GAIN

While irrigation determines the potential gain from Green
Revolution, the realized gain is likely to be influenced by resources
like working capital, credit and the availability of critical inputs like
improved seeds, fertilizers, and pesticides. Frankel and Lipton have
stressed the resource bias of the Green Revolution in favour of big
farmers as one of the main factors leading to the widening of the
existing inequalities. It is argued that the large and big farmers with
their greater command over capital resources and a greater capacity to
bear risks and uncertainties of innovation will be in a better position
to reap the benefits of Green Revolution vis-a-vis the medium and
small cultivators.

The available empirical evidence shows that under the new
technology, in terms of economic feasibility, relative cost and returns
to investment, the big farmers are clearly placed in a far superior
position vis-a-vis their smaller counterparts in reaping the benefits of
the Green Revolution. In many states in India, it is found empirically true that as farm size increases, income increases more than proportionately. A traditional agriculture, the small farmers with their relative abundance of family labour could attain relatively higher intensity of cultivation and also claim a relatively higher productivity per unit of land through increased input of human labour in farming. From the fact that the productivity per acre and the intensity of cultivation declined with an increase in the farm size, one can infer that the small farmers were able to reduce inequalities to some extent in income arising out of the unequal distribution of land among cultivating house-holds. The emergence of capital-intensive technology now seems to have shifted the advantage of productivity per acre in favour of the big farmers. Again, the very requirement of capital to carry out new agriculture has tilted the balance against the small farmers with limited access to capital and in favour of the big farmers who have not only a relatively easy access to it but can also make more rational use of it because of the favourable farm size. The greater risk bearing capacity of the big farmers puts them in a more advantageous position to exploit the new opportunities. This underscores that compared with small farmers, the big farmers stand to gain more from the new technology. Consequently the inequalities among farm families in terms of farm incomes are bound to grow under the impact of the Green Revolution. Saini found that there existed an inverse relationship between farm size and income per acre in 1950, which indicated that the then inequalities of income arising
out of the unequal distribution of land were to some extent reduced by productivity differences between the small and the large farmers, in favour of the small farms. After the setting in of the Green Revolution, this relationship has undergone a significant change. The inverse relationship has now yielded place to positive relationship. The sufficiently establishes the fact due to Green Revolution, the income gap between the small and the large farms has widened. This analysis has clearly shown an unavoidable by-product of the Green Revolution viz., the growing inequalities in house-hold incomes from agriculture which are aggravated by differences in factor endowment and resources of the different size classes of farms and the big farmers have gained considerably from the new technology ushered in by the Green Revolution.\textsuperscript{24}

In a study of four districts of Ferozepur (Punjab), Muzaffar Nagar (Uttar Pradesh), Hooghly (West Bengal) and Ahmadnagar (Maharashtra), Bardhan found that the share of top 20 per cent of farms in total farm business income has gone up in Ferozepur, Hooghly and Ahmadnagar and gone down in Muzaffar Nagar. On the other hand, the share of the bottom 30 per cent of farms in total farm business income has gone down in Ferozepur and Ahmadhagar, it has slightly gone up in Hooghly but significantly so in Muzaffar Nagar. The concentration index has gone up in Ferozepur, Hooghly and Ahmadnagar and declined in Muzaffar Nagar. In the sense of Lorenz curve dominance, the distribution of farm business income has
become unambiguously more unequal in Ahmadnagar and unambiguously less unequal in Muzaffar Nagar. For either Ferozepur or Hooghly, the Lorenz curves for the two points of time intersect, so one cannot be unambiguous about the change in inequality for the whole distribution. Muzaffar Nagar is the only clear case of a reduction in inequality.25

The Farm Management Studies conducted by the Ministry of Agriculture provided a wealth of data to examine the efficiency of Indian Agriculture. A number of conclusions were drawn from these studies by different writers. The important findings of these studies was that there existed significant difference in factor intensities and input-output ratios between different size classes of farms. In specifically observed that 1) The output per acre is inversely related to the size of farm as measured by area; 2) The input per acre (total cost including payment for all the factors of production) is inversely related to the size of farm; 3) The profit per acre is directly related to size of farm, and 4) The farms are operating at constant returns to scale.

It is found that the inverse relationship of output per hectare and farm size in the Farm Management Studies was attributed to the fact that the small farms were using more input per unit of area than the large farms. Therefore, the hypothesis that Indian agriculture is operating at constant returns to scale is rejected in the context of new agricultural technology. During the last decade, the yield increasing technology has opened vast opportunities for rapid growth of
agricultural production and realization of higher income per unit of area. Rajvir Singh and Patel, while examining these relationships in an area which has been well exposed to latest technological developments, arrived at the following conclusions,

- the gross return per standard hectare does not have any indication of inverse relationship with the farm size,
- the total cost per standard hectare showed an inverse relationship with farm size,
- the profit per standard hectare is increasing with the farm size, and,
- the sample farms are operating at increasing returns to scale.

The results of this study indicate that similar type of studies are to be conducted before reducing farm size by introducing downward land ceiling which may result in drastic cut in total agricultural production.26

Srivastsava and others says that a non-neutral technical change may be sufficient to change the distribution of income over factors, but it is only a necessary condition for a change in the distribution of income by farm size. On the other hand, embodied technical change and differences in adoption rates among the different farm size groups are sufficient conditions for a change in the distribution of income by farm size.27

Hanumantha Rao in his macro level study reveals that the technological change as such has contributed to widening the
disparities in income between different regions, between small and large farms and between land-owners on the one hand and landless labourer and tenants on the other. However, in absolute terms, the gains from technical change have been shared by all sections. This is indicated by the rise in real wages and employment and in incomes of small farmers in regions experiencing technological change. He further points out that the technological changes in general and mechanization in particular have been taking place mainly among the large farms in the high income and high growth pockets. According to Rao, has induced a high growth rate of output among the already developed regions and large farms owing to their better resource position. He contends that a very influential set of scholars belonging mainly to the western radical school and with some faithful Indian followers assert that the new technology in agriculture has benefited only the upper strata of cultivators and that the process of development embodied in the Green Revolution has led to both proletarianization and immiserisation of a vast proportion of the rural population. Some of them believe that in Indian agriculture, the mode of production has become capitalistic. Consequently, the small farmers unable to face the fierce competition from mechanized farms are selling out their land and joining the reserve army of the rural proletariat. They therefore believe that the extent of poverty has substantially increased in the Green Revolution region. It was found further that the average household income of each category of progressive counterparts. When compared with the non-progressive
cultivators, the extent of poverty was found to be much smaller amongst progressive farmers. This indicates that rather than accentuating it, the new technology has made a perceptible dent in poverty. Rao points out that in this context the wide disparities of income could be explained in terms of disparities in land holdings.\textsuperscript{28}

Sheila Bhalla indicates that there is no evidence of increasing immiserisation in the areas of Green Revolution. This, however, does mean that income inequalities have ceased to exist and that poverty and destitution have been eliminated. The fact of the matter is that there are large income inequalities in country-side. The basic reason for their existence is that the main productive asset, land, is very unevenly distributed. In context of rapid growth through the application of modern technology, Sheila Bhalla continues to argue that it tends to benefit all sections almost in proportion to their command over productive resources. It benefits landless labour as the demand for hired labour also increases. She concludes that contrary to the view propounded by the anti-growth western radicals, growth does not lead to poverty. But growth through the application of new technology does not lead to equitable income distribution either. This is only achievable according to her through radical institutional changes. Since land distribution is quite skewed, income distribution is also quite unequitable.\textsuperscript{29}

Bardhan and Srinivasan point out that it is agreed that though the new agricultural technology might be neutral to the size of holding
and might have indirectly increased employment, it is likely to have worsened income distribution in so far as the acquisition of requisite new inputs depended on initial asset holdings. Usha Rani says that the whole controversy regarding relationships between the size of farm and yield per acre was based on the aggregated data of Farm Management Studies and on disaggregated data from some other sources, and the whole controversy loses much for its importance in view of the developments which are taking place in Indian agriculture because even if the smaller farmer has certain advantages over large farmers in labour-intensive techniques, these are likely to be wiped out as capital-intensive techniques gain popularity among farmers.

The gap between the benefits is large and small holdings is to be reduced and the scope of the new technology enlarged. The less privileged cultivators must be enabled to secure the highly productive inputs. Since the distribution of credit in India reflects a power structure very much biased in favour of the affluent, it became non-existing. The argument is not against modernization for making the rich farmers richer still but against the limited scope and that the growing disparity leaves the poor peasants relatively poorer.

Nair analyzed that even though the level of income has positively grown between strategies of higher level of irrigation, the income distribution became more skewed. It is found that the medium and large farmers cash relatively more benefits that other farmers from the technological development. It is observed therefore that
cropping pattern of medium and large farmers are comparatively more sensitive to irrigation under technologically induced agricultural development. He further comments that agricultural development induced by the technological strategies particularly in a backward region will marginally affect the levels of living of the rural masses and it will accentuate the structural inequalities and any development attempt which does not take structural approach for agricultural development need to be viewed with skepticism in its impact to increase the level of income and thereby reduce the inequalities in the distribution of income.  

Bhalla and Chadha in their study of income distribution among Punjab cultivators point out that on the whole there is a rise in the following parameters as farm size increases the parameters are Remunerativeness of crop pattern, Expenditure on biochemical inputs, Irrigation facility, Overall crop yield and Farm Business Income. This pattern is in contrast to the inverse pattern of the pre-high yielding variety farming. They authors conclude that the gains from the new farm technology have accrued in direct proportion to the size of holding.  

Wharton observes that the first or early adopters of the new technology will be in regions which are already more advanced, literate, responsive and progressive and which have better soil, better water management, closer access to roads and markets in sum, the wealthier more modern farmers. For them he contends that, it is
easier to adopt the new high yielding variety since the financial risk is
less and they already have better managerial skills when they do
adopt them, the doubling and trebling of yields mean a corresponding
increase in their incomes. He argues that, as a result of different
rates in the diffusion of the new technology the richer farmers will
become richer. This raises massive problems of welfare and equity.\textsuperscript{35}

Grabowski considers that in the economies characterized by
bimodal distribution of assets and income, the induced innovation
mechanism dictates technological change in a socially inefficient and
inequitable direction. According to him in the situations of dualistic
agrarian structure, large landholders, because of their monopolistic
position, face factor paddy relations different from those faced by
small holders and the landless. Landed elites usually have better
access to institutional credit and subsidized modern inputs with the
result that the costs of non-labour inputs for them are lower than
social opportunity costs. Thus the inequitable distribution of assets
and income in dualistic rural communities will be aggravated further.
Hence, he criticizes Green Revolution on the ground that as a result of
it polarization of rural communities into large commercial farmers and
landless proletariat is promoted. Further more, the large commercial
farms have an intrinsic tendency to introduce large machinery for
ease of labour management which reduces employment opportunities
and wage rates for the landless population resulting in more
inequitable income distribution. It is agreed that Grabowski
perspective that in situations where the rural sector consists of more than one group with sharply conflicting interests, the induced innovation mechanism may fail to generate socially desirable innovations or may produce the innovations that are socially undesirable for both efficiency and equality reasons.36

Hayami considers that the Green Revolution represents a typical case in that the induced innovation mechanism worked in dualistic situations to generate technological changes biased toward the benefit of landed elites at the expense of small holders and landless labourers. He says that empirical evidence is more consistent with the hypothesis that the growing inequality in the rural sector of developing countries has been a result not of Green Revolution technology but of insufficient progress of the Green Revolution technology in overcoming population pressure on land.37

Feder and Mara while discussing the relation between farm size and diffusion of the Green Revolution technology dispute that the analytical model and the simulations demonstrate that larger farmers start with experimental plots increasing in size, while smaller farmers lag behind, reaching the adoption decision when larger farmers have already enjoyed several seasons of higher yields. Therefore, that the income distribution is likely to deteriorate in the initial stages, improving only when the smaller farmers join the rank of adopters.38

Mishra observes that the flow of marketable surplus being the main source of income generation depends on two factors, namely,
size of farm and level of technology. The larger the size of farm with higher level of technology, the larger the produce and so the amount of marketable surplus. A number of studies made in the context of new farm technology show that the large farmers benefit much more than those having small and marginal land holdings from the use of that new technology, having their greater control over the supply of scarce agricultural resources, credit worthiness and technical dynamism. Thus the infers that given other factors, the size of land holdings is the main determinant of production and surplus and it is also an important force to facilitate the use of modern technical inputs. The process of income distribution will thus take place accordingly. He further contends that marketable surplus, being a function of farm size, leads to the second relation that the larger the size of holdings, the greater the marketable surplus and consequently, the smaller the degree of market dependence for consumption. Thus the flow of farm income is a function of marketable surplus and agricultural paddy; and the process of income distribution is conditioned and determined by the size of land holdings, the flow of surplus produce, and the degree of market dependence for consumption. The process of income distribution is thus itself built into the agrarian structure of production process and relations. As a result, there exists a built-in bias towards distributing the flow of agricultural produce and the gains of development from planning in favour of those who own and cultivate large holdings as against the peasant cultivators who own and operate small or marginal farms.39
Utsa Patnaik on the basis of a survey of 66 big farmers scattered over a wide area of the country showed that a new class of capitalist farmers is emerging—though the rate at which capitalist development is occurring varied widely in different regions. Mishra also finds that the development of capitalism in agriculture, which is taking place in its large farm sector is bound to create a wide gap of incomes between the rich and poor despite a rapid increase in agricultural production. Given the agrarian structure, the large farm sector will always benefit from the capitalistic process of development operating from planning. In other words, the capitalistic process of agricultural development with the existence of a large number of poor peasants and landless labour will create greater dualism with an uneven distribution of incomes accruing to the rural sector of the economy.

Sadhu and Mahajan in a study in Jammu and Kashmir and Punjab, which were selected for the introduction of IADP observe that the Green Revolution has resulted in accentuating regional income inequalities and the farm income inequalities are larger in the comparatively much advanced Batala block than that of Marh which is comparatively less developed. The study highlights the relative importance of different factors which polarize the income distribution. However farm income inequality is largely influence by farm size. It is concluded that rapid technological changes have the impact of widening the income disparity in the farm economy of the Punjab.
more than in Jammu & Kashmir, even though the distribution of factors like area under high yielding varieties of seeds, yield increasing divisible technology, hired labour, cropping intensity etc. are less unequal in Punjab than in Jammu & Kashmir.\(^4^2\)

Singh and Kahlon that the new farm technology has resulted in a trend towards more even distribution of farm business incomes rather than aggravating income inequalities. May be, initially the inequalities might have increased but with the diffusion of the benefits of new farm technology to all the categories with the passage of time, the tendency towards a more equal inter-size distribution of incomes has began to show itself more prominently. It appears that the benefits of the new technology which were monopolized and grabbed by the larger farmers because of their credit position and social status are getting more widely diffused now. Further, the Governmental policies regarding land reforms have also resulted in a more even distribution of land holdings. Besides, increasing population pressure on land has also evened out the ownership pattern of holdings. Another reason accounting for this tendency is the provision of irrigation facilities. Moreover, the small farmers are increasingly resorting to leasing in more areas to enlarge the size of their operational holding. All these factors have the cumulative effect of reducing inequalities in income distribution.\(^4^3\)

Krishna Bharadwaj in her extensive study finds that both in terms of output and equity, the small farmers are benefited much and
the large farmers are not realizing the benefits as expected, from the investment of inputs under the new technology. In short, she finds the existence of the inverse relationship between the size of holding and the different variables, particularly between farm size and yield and farm business income.44

The inequality in the distribution of rural income is significantly lower than that in the distribution of ownership or operational holdings because output per acre is generally higher among smaller holdings and because small income groups account for a predominant share in income from non-crop enterprises and derive a significant part of their income as wage bill from the large farmers. The degree of income inequality would be less than that in landholdings, the farmer is directly related to the latter. Malone in an early study of an IADP district of Thanjavur finds that there are no really important differences in the way farmers of different size farms are responding to opportunities to modernize their production method. Summing up the experience, Malone, observes that the small farm are active in increasing the use of fertilizer and related practices, the most available modernizing input generally in use. The studies made in the IADP areas the Expert Committee on assessment and evaluation concluded that the operators of small farmers were in the forefront of production in many areas and were often ahead of the operators of medium and large farms in respect of adoption of new varieties and practices.45
Sohoni and Khandarkar have shown that although the income gap between the large and small farmer had widened with the increase in irrigation facilities in absolute terms, in terms of growth rate, the small farmers have done better. The rate of increase of income of small farmers was four times compared to only two times in the case of large farms. Kali K. Rajan shows that economic opportunities provided by high yielding varieties were utilized efficiently by sample participants regardless of farm size. He further stressed that given the same access to inputs and equal terms, the small farmers will respond to economic opportunities in the same way as large farmers, and as such, in order to achieve this, special institutional arrangements may be necessary to ensure equal access for small farmers to inputs.

Changes in production technology have been taking place in Indian agriculture over the past two decades or so with the introduction and spread of high yielding varieties of crops and intensive application of complementary modern farm inputs. It promises agricultural growth and improvement in the welfare of the farm people. It however, has certain important implications arising out of the distribution of its benefits. The new agricultural technology with it is resource-bias coupled with skewed distribution of land concurrently impeded the small farmers in taking advantage of the gains offered by the new technology. Consequently, the benefits of growth have not trickled down to the impoverished masses and thus the introduction of new technology exacerbates inequalities in income.
The three distinct strategies or approaches to development followed by underdeveloped countries for attaining development are the technocratic, reformist and radical. The differences in objectives, ideologies, institutions and distribution of these strategies constitute differences in their style. The Prime economic objective of the *technocratic* strategy is to increase agricultural output either by incorporating more conventional inputs such as land, or by encouraging farmers to adopt and improved technology. The economic system has been justified essentially in terms of a liberal capitalist ideology. As such, the benefits of technological change and higher output accrue at least in the first instance to the land owning elite and other men of property. The concentration of income and wealth is one of the ways whereby the output objective is expected to be achieved. This is evident in the case of India where despite growth in output, absolute poverty persists, for, the benefits of growth have not trickled down to the poorest. Since the policy of agricultural strategy in India is of technocratic style the Green Revolution has increased economic inequality and in turn aggravated social conflicts which already existed.

The objectives of radical strategy are mass participation, economic equality and faster growth in respect of priority. In a democratic country like India, this strategy is inappropriate and incompatible as this strategy is supported by the ideology of socialism where rough equality is achieved by abolishing private property in
land. Finally the reformist strategy on the other land is basically a compromise between the two extreme positions and places priority on redistribution of income to some sections of the community and accordingly attributes lower priority than the technocratic strategy to increasing agricultural output. Attempts are made to reconcile greater equity with faster growth by changing agrarian institutions. However, quite often, in practice, the reforms are partial, fragmented and incomplete and concentrated in certain regions to the exclusion of others. Consequently, this style creates a dualistic or bi-nodal agricultural sector. This is very clear in India where a policy of redistribution of land in favour of the peasantry is not successful while a policy of encouraging capital-intensive farming on large holdings was pursued in the irrigated areas. As a result, poverty and inequality have been exacerbated.
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